(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
30 May 2002 (30.05.2002)

PCT

(10) International Publication Number
WO 02/43405 A1

(51) International Patent Classification[7]: H04Q 3/00, 7/38, 7/24

(21) International Application Number: PCT/EP00/11845

(22) International Filing Date:
27 November 2000 (27.11.2000)

(25) Filing Language: English

(26) Publication Language: English

(71) Applicant *(for all designated States except US)*: **NOKIA CORPORATION** [FI/FI]; Keilalahdentie 4, FIN-02150 Espoo (FI).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **PIRKOLA, Juha** [FI/FI]; Pakkamestarinkatu 3 D 137, FIN-00520 Helsinki (FI). **KAUPPINEN, Risto** [FI/FI]; Kirjurinkuja 3 C 22, FIN-02600 Espoo (FI).

(74) Agents: **LESON, Thomas, Johannes, Alois** et al.; Tiedtke-Bühling-Kinne, Bavariaring 4, 80336 München (DE).

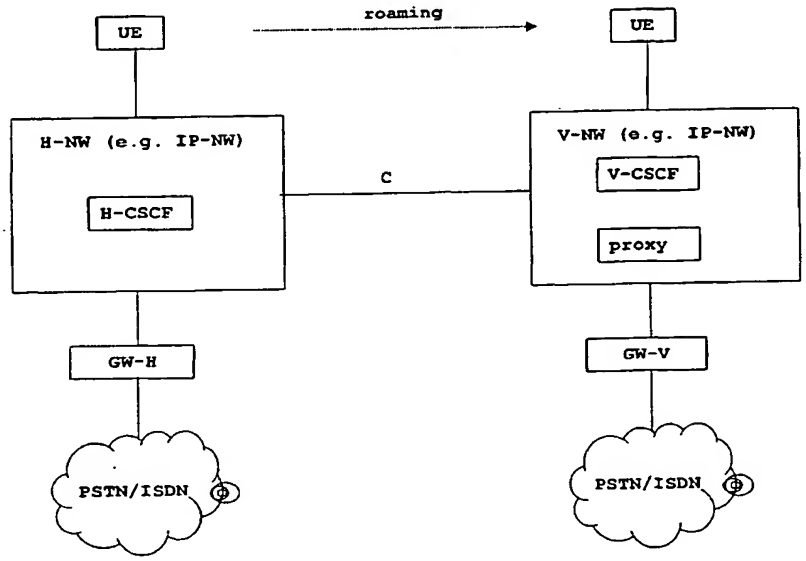
(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published:
— *with international search report*

[Continued on next page]

(54) Title: A METHOD FOR CALL ROUTING IN A COMMUNICATION SYSTEM



(57) Abstract: A method for call routing in a communication system, said communication system comprising a first (H-NW) and a second (V-NW) communication subsystem of a respective first type, adapted to handle calls for a subscriber terminal (UE) having roamed to the second communication subsystems . Said first and second subsystems are provided with at least one subsystem of a second type and at least one call control entity (H-CSCF, V-CSCF). The call control entity of one of said first and second subsystem, whic is in charge of handling calls for a roamed subscriber, is determined. After verifying the destination of the initiated call, if the route for said call goes via the other of said first or second subsystem, the call control entity in charge is provided with information concerning at least one interface entity (GW-V, GW-H).

WO 02/43405 A1

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

TITLE OF THE INVENTION

A METHOD FOR CALL ROUTING IN A COMMUNICATION SYSTEM

FIELD OF THE INVENTION

The present invention relates to a method for call routing in a communication system.

BACKGROUND OF THE INVENTION

Recently, communication systems have been proposed which enable the transmission of data and/or speech (as a "special" kind of data) in a packetized form. An example of such communication systems is the IP based communication network, which is operated on the basis of the Internet Protocol (IP). Also, such transmission is generally referred to as VoIP (Voice over IP).

On the other hand, data / speech was conventionally transmitted using circuit switched communication systems. An example of such circuit switched communication systems is the public switched telephone network (PSTN) and/or the integrated services digital network (ISDN).

Nowadays, both of the above mentioned communication system types (packet switched IP and circuit switched PSTN/ISDN) are present in parallel. Thus, each of the above systems may be regarded as constituting a communication subsystem of the overall communication system.

A link and/or interface between these communication subsystems of different types is established by so-called gateway entities, which enable a communication between communication subsystems of different types. Namely, such a

gateway provides an interworking between packet switched communication subsystems (networks) and circuit switched communication subsystems (networks).

Fig. 1 of the accompanying drawings illustrates a basic communication system arrangement. It is to be noted that only those components are illustrated which are considered to be involved in the present invention, while other details are omitted from the illustration in order to keep the drawing simple for explanatory purposes.

As shown in Fig. 1, the entire communication system comprises a first (i.e. home network) H-NW and a second (i.e. visited network) V-NW communication subsystem of a respective first type (packet switched network such as for example an IP based network), which are adapted to handle the communication for a subscriber terminal UE having roamed from said first to said second communication subsystems (i.e. from his home network H-NW to a visited network V-NW, as indicated by the arrow labeled "roaming"). Also, each of said first and second subsystems of said first type are provided with at least one interface entity also referred to as gateway entity GW-H, GW-V to at least one respective third communication subsystem of a second type (circuit switched network such as for example PSTN, ISDN). Still further, each of the first and second subsystems has at least one call control entity H-CSCF, V-CSCF controlling the call handling for a subscriber terminal. Also, the subsystems H-NW, V-NW comprise at least one proxy server entity (although shown only in the visited network V-NW).

The subscriber terminal may be a mobile terminal also known as mobile station (MS) or as user equipment UE (adapted for wireless communication with the network). Nevertheless, a

non-wireless but still portable terminal may be conceivable which can be plugged in to the different networks. The term "terminal" as used herein is therefore to be understood in its broadest sense.

The third communication subsystem(s) PSTN/ISDN may be the same subsystem, but may also be different subsystems which are connected to each other via another gateway (not shown). Nevertheless, for the purpose of the present invention it could be deemed sufficient to assume that there is some kind of connection between the individual blocks PSTN/ISDN or that they constitute together a single PSTN/ISDN subsystem.

The first (home network) and the second (visited network) communication subsystems are connected by a connection denoted by C in Fig. 1. Via this connection C, information is exchanged such as an information that the subscriber terminal has roamed from the first to the second subsystem.

Thus, the home network has a knowledge that the subscriber has roamed, i.e. that the subscriber is no longer present within the area of his home network, but is present within the area of the visited network.

However, in general, a network or subsystem, respectively, has only a knowledge of its own resources, but does not have a knowledge concerning the resources of another network or subsystem, respectively. Stated in other words, for the roaming subscriber terminal UE the home network H-NW is not aware of the resources (such as gateway addresses) of the visited network, and vice versa.

Therefore, as regards routing of calls in such a communication system as described in connection with Fig.

1, which consists of a packet switched domain (e.g. IP telephony) and a conventional circuit switched domain (e.g. PSTN/ISDN), the efficient routing of a call presents a problem.

Namely, in case a roamed subscriber now communicating in/via the visited network intends to call a communication partner in its home network H-NW, or a communication partner in a PSTN/ISDN network associated (connected) to its home network, there might arise a situation, in which the visited network has to select the gateway of the visited network to route the call via the PSTN/ISDN network connected to the visited network V-NW, from there to the PSTN/ISDN connected to the home network H-NW (or even further to the home network itself.

Apparently, most of the call routing would be effected via the circuit switched domain. However, the circuit switched call routing is deemed to involve much higher costs for a call than routing a call in the packet switched domain such as an IP based network.

Previously, a theoretical approach has been presented for solving such problems which turned out with the spreading of (packet switched) IP telephony. According to this approach, a new protocol named TRIP has been developed. However, the TRIP solution can not yet be implemented as a specific network infrastructure adapted to TRIP is required to be globally available.

SUMMARY OF THE INVENTION

Hence, it is an object of the present invention to solve the above problems.

More specifically, the present invention aims to optimize call routing in a communication system for a call crossing the border between a packet switched communication subsystem domain and a circuit switched communication subsystem domain under the viewpoint of minimizing transmission costs while not requiring a specifically adapted communication system infrastructure.

According to the present invention, this object is for example achieved by a method for call routing in a communication system, said communication system comprising at least a first and a second communication subsystem of a respective first type, adapted to handle communication for a subscriber terminal having roamed from said first to said second communication subsystems, each of said first and second subsystems of said first type being provided with at least one interface entity to at least one respective third communication subsystem of a second type, and at least one call control entity, said method comprising the steps of: determining the call control entity of one of said first and second subsystems to be in charge of handling calls for said roamed subscriber; detecting the destination of an initiated call; verifying, that the call control entity of one of said first or second communication subsystems H-NW, V-NW is determined to be in charge of handling calls, whereas the route for said initiated call is detected to go via the other of said first or second communication subsystems; and, upon verification, providing the call control entity in charge with information concerning an interface entity of said other of said first or second communication subsystems.

According to further developments of the present invention

- there is a step of downloading an address of at least one interface entity of said first communication

subsystem to said second communication subsystem if it is determined that the call control entity of said second subsystem is in charge of handling calls for said roamed subscriber;

- said step of providing comprises reading the address of the interface entity in said first communication subsystem, which is stored in said second communication subsystem and enabling the use of the read address by said call control entity of said second subsystem;

- the call is routed to the interface entity in said first communication subsystem (H-NW) based on the read address;

- said address downloading is effected by embedding the address information into the mobile application protocol (MAP);

- said address downloading is effected by embedding the address information into the lightweight directory access protocol (LDAP);

- each address of an interface entity is associated with at least one called party identification set, and said called party identification sets are used by said second communication subsystem (V-NW) to route said call to the associated interface entity;

- said step of providing comprises submitting an address of the interface entity of said second communication subsystem to said call control entity of said first communication subsystem, if it is determined that the call control entity of said first subsystem is in charge of handling calls for said roamed subscriber;

- said call control entity of said first communication subsystem re-routes the call to the interface of said second communication subsystem specified by said address;

- said address is submitted being embedded in a call setup message;

- said call setup message is transmitted using a session initiation protocol (SIP).

- said first type of communication subsystems is packet switched, and said second type of communication subsystems is circuit switched;

- said interface entity is a gateway functional entity.

Still further, the present invention proposes a computer program product comprising a computer readable medium on which there is stored computer program code which when loaded into and executed by a computer device is adapted to execute a procedure as defined above.

Stated in other words, when a mobile user/terminal is roaming in a visited network V-NW, a corresponding registration is made to the user's home network H-NW. In the registration procedure the location of call state control CSCF is decided to be either in the visited network (V-CSCF) or in the home network (H-CSCF).

Now, in brief, according to the present invention

a) if call state control is located in the visited network, then the address of a call routing entity in the home network is downloaded to the visited network during such registration. When the subscriber later places a call to his home network, the visited call state control entity V-CSCF can use this address to route the call optimally.

b) if the call state control is located in the home network, and the subscriber makes a call to the visited network, then a proxy functional entity in the visited network adds to the call setup message the address of a call routing entity in the visited network. The call state control function in the home network can then route the call back to the visited network in an optimal way by using the address of the call routing entity.

By virtue of the present invention, at least the following advantages can be obtained:

1) a call is routed as far as possible within the packet switched domain (IP domain), thus enabling the finding of the optimal gateway, i.e. the one which is closest to an endpoint (e.g. in the PSTN/ISDN),

2) finding and thus selecting the gateway closest to an endpoint enables the minimization of transmission costs for a respective call, as the costs for a packet switched communication are considerably lower than the costs for a circuit switched communication,

3) the routing problem for two special but typical cases is solved, namely, when a user roams in a foreign (visited) network and places a call to his home network or to the visited network,

4) the proposed specific solution can be employed with the existing communication systems' infrastructure, and no new infrastructure needs to be conceived and implemented,

5) information about the closest and/or nearest gateway can be embedded either during the registration procedure of the terminal to the visited network or during call setup for a call to the home network, and

6) the information can easily be embedded in existing messages/protocols such as the Mobile Application Part MAP and/or the Session Initiation Protocol SIP.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and further objects and advantages of the present invention will become more fully apparent upon referring to the accompanying description of preferred embodiments in conjunction with the attached drawings, in which:

Fig. 1 illustrates a basic communication system arrangement;

Fig. 2 shows a flowchart of a process performed upon registration that a subscriber has roamed from his home to a visited network;

Fig. 3 depicts a flowchart of a process performed upon detection that a subscriber places a call from the visited network towards either the visited or his home network; and

Figs. 4 and 5 illustrate signaling scenarios in connection with a modification of the present invention.

DETAILED DESCRIPTION OF EMBODIMENTS

Generally, as mentioned above, the present invention is suitable to optimize routing of a mobile originated call, since, generally a network can not know the resources in another network, which means that for a roaming user the home network can not know the resources (e.g. gateway addresses) of the visited network, and vice versa. An optimization is effected

a) in case the call state control is located in the visited network, and a call is made to the home network, and

b) in case the call state control is located in the home network, and a call is made to the visited network.

In case a) the solution to optimize the call routing resides in that in a registration phase, the address of a call routing entity (i.e. a gateway entity) residing in (located in or allocated to) the home network is downloaded to the visited network along with the subscriber's service profile. Then, when the visited call state control entity

detects that the mobile subscriber is making a call to its home network, it can route the call to the stored address of the call routing entity in the home network. Without this address the visited network might have to select a PSTN gateway in (allocated to) the visited network and to route the call through PSTN which is not optimal.

For case a) above, the protocol that carries subscriber profiles (e.g. GSM MAP) is enhanced to carry also information (e.g. addresses) about call routing entities (gateways) in the home network. This means basically standardizing and implementing the new information element to the protocol.

In case b) the solution to optimize the call routing resides in that there is a proxy functional entity in the visited network, which can detect a mobile originated call that is made to the visited network. The proxy functional entity adds to the call setup message the address of a call routing entity (gateway) in the visited network. When the call setup is processed in the call state control entity in the home network, the information added by the proxy can be used to route the call to the address of the call routing entity that resides in the visited network. Without this information the home network might have to select a PSTN gateway in (allocated to) the home network, and the call would be routed through the PSTN which is not optimal.

For case b) above, the protocol that carries call control messages (e.g. SIP) is enhanced to carry information (e.g. addresses) about call routing entities (gateways) in the visited network. This means basically standardizing and implementing the new information element to the protocol.

The present invention will now be described in greater detail with reference to the drawings.

Fig. 2 shows a flowchart of a process performed upon registration that a subscriber has roamed from his home to a visited network.

The process starts in step S20. Thereafter, in step S21, it is detected that the user equipment / terminal is roaming and/or has roamed from its home network H-NW (first communication subsystem) to a visited network V-NW (second communication subsystem). The fact that the user equipment UE is no longer present in the home network H-NW is registered in step S22 to the home network. In the course of this registration, in step S23, a determination on the location of the call state control functional entity in charge of handling calls for the roamed subscriber's user equipment is effected.

Such a determination is known as such and not described here in greater detail. As a result of such a determination, either the call control entity (call state control functional entity CSCF) of the home network H-CSCF remains responsible for handling calls for the roamed subscriber's user equipment, or this responsibility is transferred to the call control entity of the visited network V-CSCF.

The result of the determination effected in step S23 is checked in step S24. If the call control entity of the home network H-CSCF remains in charge of call control for the roamed user, the flow branches to the left in Fig. 2 and the process is continued from step S31 in Fig. 3 onwards (to be described later). If, however, the call control entity of the visited network V-CSCF is made responsible

for call control for the roamed user, the flow branches to the right in Fig. 2 and the process is continued with step S25. In step S25, the home network H-NW downloads, to the visited network V-NW, an information identifying a gateway GW-H of the home network H-NW towards a circuit switched subsystem (PSTN/ISDN) allocated to the home network. The downloaded information may be an address of the gateway. Also, the information (address) may be transmitted being embedded in a Mobile Application Part (MAP) signaling. The downloaded information is stored in an appropriate database entity (not shown in the Figures) of the visited network V-NW from where it can be retrieved/read. Thereafter, the process proceeds also from step S25 in Fig. 2 towards step S31 in Fig. 3.

Fig. 3 depicts a flowchart of a process performed upon detection that a subscriber places a call from the visited network towards either the visited or his home network. More precisely, Fig. 3 continues the process flow of steps S24, S25 of Fig. 2.

Then, in step S31 shown in Fig. 3, it is detected by the visited network V-NW that the user equipment UE of the roamed subscriber initiates a call (i.e. a mobile originated call is detected). This detection is performed, for example, by a proxy functional element in the visited network.

Thereafter, in step S32, it is determined which call control entity H-CSCF or V-CSCF has previously been determined (step S23 in Fig. 2) to be in charge for handling calls for the roamed subscriber. If in step S33 the check yields that the H-CSCF is in charge, the flow branches to the left in Fig. 3, while otherwise, if the V-CSCF is in charge, the flow branches to the right.

In any of the two cases, in subsequent steps S34a and S34b, respectively, the destination of the terminal originated call is detected. The detection is effected by an appropriate functional entity of the visited network such as a proxy functional entity (proxy server), or the like. Also, if it is judged in both cases, steps S35a and S35b, respectively, that the call destination is the same communication subsystem (network) in which the call control entity in charge is located, the flow branches to step S36 and another (conventional) processing of the call is performed. Stated in more detail, if the H-CSCF is in charge for a call from the user equipment and the call is directed towards the home network H-NW, the flow branches to step S36, while also if the V-CSCF is in charge for a call from the user equipment and the call is directed towards the visited network V-NW, the flow branches to step S36.

Only in case it is judged and/or verified that the call control entity of one of said first or second communication subsystems i.e. H-NW or V-NW is determined to be in charge of handling calls, whereas the destination of (i.e. route for) said initiated call is detected to be (i.e. go via) the other of said first or second communication subsystems, i.e. V-NW, H-NW, the flow continues from step S35a to S37 and/or from step S35b to step S38, respectively, such that the process according to the present invention is continued.

Such a verification may be performed by a proxy CSCF which checks and/or determines in which network the serving CSCF for the call resides (H-NW or V-NW) as such a proxy CSCF contains and/or has a knowledge of an address of the serving CSCF.

Now, having regard to the left hand part of Fig. 3, upon judging that the call is directed to the visited network V-NW in step S35a while the call control entity H-CSCF of the home network is in charge for the call handling for the user equipment, the flow advances to step S37. In step S37, the proxy functional entity of the visited network adds information (e.g. address) for identifying a gateway functional entity (GW-V) of the visited network V-NW to a call setup message (forwarded to the H-CSCF). This information is for example embedded in the call setup message using the Session Initiation Protocol SIP.

Subsequently, the thus received call setup message is processed in the call control entity H-CSCF of the home network, the gateway information is retrieved therefrom, and on the basis thereof, the H-CSCF re-routes the call to the visited network V-NW, more specifically, to the gateway GW-V identified in the call setup message. Thereafter, the process advances to step S40, and the call establishment and routing is continued (in this case, based on the re-routed call).

Now, having regard to the right hand part of Fig. 3, upon judging that the call is directed to the home network H-NW in step S35b while the call control entity V-CSCF of the visited network is in charge for the call handling for the user equipment, the flow advances to step S38. In step S38, the information (address) of a gateway GW-H in the home network H-NW is read from a storage location in the visited network V-NW to which this information has previously been stored (see step S25 in Fig. 2). Based on the thus read information, the call is routed from the visited network V-NW towards the home network, more specifically, towards the gateway GW-H of the home network. Also after step S38, the

process advances to step S40 and the call establishment and routing is continued (in this case, based on the forward-routed call).

As such call establishment and routing as such is performed in a known manner, a description thereof appears to be dispensable in connection with the present invention.

Up to here, the present invention has been described with reference to a particular example for explanation purposes. Nevertheless, various modifications are conceivable while the present invention remains applicable.

Modification #1:

Although Fig. 1 illustrates a single interface /gateway entity GW for each communication subsystem only, it is of course possible that there are provided multiple gateways per subsystem. Each of such multiple gateways is provided for establishing an interface to a PSTN/ISDN subsystem in a specific region, for example. In detail, a first gateway might be adapted to provide an interface to the PSTN/ISDN in the Helsinki area, while a second gateway might be adapted to provide an interface to the PSTN/ISDN in the Oulu area.

In such a case, the information to be transmitted in order to inform the first/second subsystem from gateways located in the second/first subsystem has to be modified.

There exist for example the following possibilities:
1) a default information indicating a specific gateway of a plurality of gateways is transferred, and routing of a call is then performed on the basis of said default gateway;
2) information indicating all gateways are transferred to the respective other communication subsystem, an

appropriate one is selected on the basis of the information regarding the destination of a call, and the routing is based on the selected gateway.

Modification #2:

Herein before, it has generally been referred to information for identifying a gateway, with the address of an gateway being chosen as an example only.

However, instead of transferring an address directly, it is conceivable to transfer, to one of said subsystems, an information indicating a storage location (database) in the respective other network, from which the address or addresses of the gateways can be retrieved, thereby performing an indirect address information transfer.

This is particularly suitable in case more than one gateways are present in a respective subsystem (network), because then irrespective of the number of gateways, always the same amount of information (i.e. storage location address of gateway addresses) could be transferred to the other subsystem so that the amount of information (additionally) to be transmitted could be kept small.

Modification #3:

In a further modification of the invention, the home network (more particularly, a home subscriber server entity of the home network, not shown in Fig. 1) could, by an insertion to subscriber data, indicate to the visited network's CSCF/SPD (SPD = Serving Profile Database entity associated to a CSCF, not shown in Fig. 1) a reference to one or more I-CSCF (interrogating CSCF) in the home network which are used to route calls to the PSTN. The actual determination of the MGCF (Media Gateway Control Function) which sets up the call at the PSTN interface is left to the

I-CSCF within the home network. The reference can be an address or a logical name.

The benefit of the HSS indicating the I-CSCF reference includes that the I-CSCF could accommodate services that participate in the completion of the call towards the PSTN. The I-CSCF could store call processing language scripts (SIP CPL) associated with the calling party. The CPL scripts stored in the I-CSCF and associated with the calling party are executed whenever a call set-up request arrives at the I-CSCF. The call processing language scripts can complete their execution when the call set-up request has been processed, or they can remain controlling the call. The call processing language scripts could perform, for instance, address translation or outgoing call screening.

Similarly, the call processing language scripts could detect call set-up failures to the primary destination and assist in routing the call to alternative destinations. Other examples of CPL script facilities are defined in the SIP call processing language specification.

The I-CSCF could also act as a service node entity executing other kind of services associated with the calling party. These services are executed when there is an incoming call attempt received to the I-CSCF where the calling party is identified in the call set-up request. These services could prompt additional information from the calling party to enter further information relating to the call set-up request. The information could, for instance, also be prompted using a voice announcement menu application. This information is further utilized in the call set-up to PSTN.

Other examples of services executed in the I-CSCF include various premium rate call or session services. These services typically include a higher charge for the calling party. The principle is that the I-CSCF, or a service execution environment in association with the I-CSCF, determines, based on the called party identification carried in the call set-up signaling, the rate for the call. The charging could depend on call duration or it could be a one time charge applied at the start of the call. There can be a mapping from the called party identifier (such as the called party number) to the tariff of the call performed by the service.

The benefit of the above solution is that the call tariff can be determined in the IP mobility subsystem i.e. in the packet switched communication system side. In this way the call detail records for the premium rate calls can be generated in the I-CSCF. If the calls didn't go via the home network determined I-CSCFs or MGCFs, there would be no guarantees that the premium rate calls are routed via I-CSCFs or MGCFs that can analyze the called party identification to determine the premium rate tariff for the call.

The I-CSCF reference could actually specify a set of physical I-CSCFs, each storing the required services. The I-CSCF reference could be resolved into different physical I-CSCF addresses, for instance, a domain name resolving performed by the visited network CSCF.

In a further embodiment of the invention, the HSS could specify a set of I-CSCFs and called party identification criteria associated with them. The visited network CSCF would select the I-CSCF to which the call must be routed based on the called party identification criteria. The

criteria could be specified as address prefixes or as domain name labels. In this connection, it is to be noted that also the I-CSCF may be regarded as an interface entity (like a gateway and/or media gateway).

Figs. 4 and 5 illustrate the above described modification as signaling diagrams.

In Fig. 4, the home network is represented by the home subscriber serer entity HSS, while the visited network is represented by V-CSCF/SPD, i.e. the CSCF of the visited network V-CSCF and its associated serving profile database SPD. Upon a detection that a user equipment (e.g. a user equipment identified by Uex as an identification for a user equipment as a calling party) has roamed to the visited network (see step S21 in Fig. 2), a registration process is conducted (see also step S22 in Fig. 2) as illustrated in step S41. As shown in step S41, the V-CSCF/SPD signals to the HSS of the home network that the user equipment Uex has registered (due to roaming) to the visited network, and the HSS registers this fact. After a subsequent signaling of subordinated relevance in connection with the presently described modification of the invention, which signaling is therefore omitted from Fig. 4, the HSS of the home network forwards, in step S42, subscriber data related to the user equipment UEx to the V-CSCF/SPD. Inserted in these subscriber data is a reference to a I-CSCF of the home network, e.g. I-CSCFy, as described above (see also step S25 in Fig. 2). In a subsequent step S43, the V-CSCF/SPD acknowledges the receipt of the subscriber data and inserted references to an I-CSCF to the HSS.

In Fig. 5, the user equipment UE, more specifically UEx, having roamed to the visited network and the V-CSCF represent the visited network, while the home network is

represented by the I-CSCF identified by I-CSCFy and a MGCF (as an example of a gateway entity GW shown in Fig. 1). In step S50, the user equipment UEx sends a call set-up request to the V-CSCF. The request contains the user equipment identification UEx and the call destination B-ID (e.g. a telephone number). In a following step S51, the V-CSCF determines that the identifier B-Id refers to a PSTN terminal so that routing via the home network is optimal. The stored identifier I-CSCFy for the I-CSCF in the home network is recalled. Thereafter, in step S52, the V-CSCF forwards the call set-up request including UEx and B-Id to the recalled I-CSCF of the home network, i.e. to the I-CSCF denoted by I-CSCFy. The I-CSCFy in step S53 then invokes services associated with the user equipment UEx. After a subsequent signaling of subordinated relevance in connection with the presently described modification of the invention, which signaling is therefore omitted from Fig. 5, the I-CSCFy forwards the call set-up request including UEx and B-Id to the MGCF as a gateway considered most appropriate for routing the call to the destination B-Id. In step S55, this gateway MGCF performs call completion at the PSTN/ISDN interface. (The above described signaling is related to the flowchart steps S34b, S35b, S38, S40 of Fig. 3). (Note that in Figs. 4 and 5 UEx is the calling party identification, I-CSCFy is the I-CSCF reference and B-Id is the called party number or logical name.)

Furthermore, it is to be noted that although herein above the specification mentioned that a call is made to the home and/or visited network, this expression is intended to cover also the case that a call is made to a circuit switched (e.g. PSTN/ISDN) subsystem respectively allocated to the home/visited network, while this does not impose a change on the present invention.

Thus, the present invention relates to the call set-up from e.g. an all-IP network as an example of a packet switched network subsystem to circuit switched networks (e.g. PSTN/ISDN). The invention advantageously optimizes call routing so that the call is routed as far as possible within the packet switched (e.g. IP) domain. There are two cases of optimization presented in the present invention: when the CSCF is located in the visited network and the call is made to the home network and when the CSCF is located in the home network and the call is made to the visited network. The invention introduces two ways to embed information about the nearest telephony gateway to the UE registration procedure. Namely, if the call control is located in the visited network, the address of a call routing entity i.e. the telephony gateway address is sent in the registration response message to the CSCF within the visited network, and if the call control is located in the home network, there is a proxy within the visited network, which detects when a mobile originated call is made to the visited network. The proxy adds the visited network telephony gateway address to the call set-up message. The address is then used by the home network CSCF to route the call to the visited network telephony gateway.

Accordingly, as has been described herein above, the present invention proposes a method for call routing in a communication system, said communication system comprising at least a first H-NW and a second V-NW communication subsystem of a respective first type, adapted to handle communication for a subscriber terminal UE having roamed from said first to said second communication subsystems, each of said first and second subsystems of said first type being provided with at least one interface entity to at least one respective third communication subsystem of a second type, and at least one call control entity H-CSCF,

V-CSCF, said method comprising the steps of: determining S23, S33 the call control entity of one of said first and second subsystems to be in charge of handling calls for said roamed subscriber; detecting S34a, S34b the destination of an initiated call; verifying, that the call control entity of one of said first or second communication subsystems H-NW, V-NW is determined S33 to be in charge of handling calls, whereas the route for said initiated call is detected S34a, S35a, S34b, S35b to go via the other of said first or second communication subsystems V-NW, H-NW; and, upon verification, providing S37-S39, S38 the call control entity in charge H-CSCF, V-CSCF with information concerning at least one interface entity GW-V, GW-H of said other of said first or second communication subsystems.

Although the present invention has been described herein above with reference to its preferred embodiments, it should be understood that numerous modifications may be made thereto without departing from the spirit and scope of the invention. It is intended that all such modifications fall within the scope of the appended claims.

Claims

1. A method for call routing in a communication system, said communication system comprising at least a first (H-NW) and a second (V-NW) communication subsystem of a respective first type, adapted to handle communication for a subscriber terminal (UE) having roamed from said first to said second communication subsystems, each of said first and second subsystems of said first type being provided with at least one interface entity to at least one respective third communication subsystem of a second type, and at least one call control entity (H-CSCF, V-CSCF),

said method comprising the steps of:

- determining (S23, S33) the call control entity of one of said first and second subsystems to be in charge of handling calls for said roamed subscriber,
- detecting (S34a, S34b) the destination of an initiated call,
- verifying (S35a, S35b), that the call control entity of one of said first or second communication subsystems (H-NW, V-NW) is determined (S33) to be in charge of handling calls, whereas the route for said initiated call is detected (S34a, S35a, S34b, S35b) to go via the other of said first or second communication subsystems (V-NW, H-NW), and
- upon verification, providing (S37-S39, S38) the call control entity in charge (H-CSCF, V-CSCF) with information concerning at least one interface entity (GW-V, GW-H) of said other of said first or second communication subsystems.

2. A method according to claim 1,
further comprising a step of
- downloading (S25) an address of at least one interface entity of said first communication subsystem (H-NW) to said second communication subsystem (V-NW), if it is determined (S23, S24; S33, S35b) that the call control entity of said second subsystem (V-NW) is in charge of handling calls for said roamed subscriber.

3. A method according to claim 2,
wherein said step of providing comprises
- reading (S38) the address of the at least one interface entity (GW-H) in said first communication subsystem (H-NW), which is stored in said second communication subsystem (V-NW) and enabling the use of the read address by said call control entity of said second subsystem (V-NW).

4. A method according to claim 3,
further comprising the step of
- routing (S38) the call to the interface entity in said first communication subsystem (H-NW) based on the read address.

5. A method according to claim 2, **wherein**
said address downloading is effected by embedding the address information into the mobile application protocol (MAP).

6. A method according to claim 2, **wherein**
said address downloading is effected by embedding the address information into the lightweight directory access protocol (LDAP).

7. A method according to claim 2, wherein

- each address of an interface entity is associated with at least one called party identification set, and
- said called party identification sets are used by said second communication subsystem (V-NW) to route said call to the associated interface entity.

8. A method according to claim 1,
wherein said step of providing comprises
- submitting (S37, S39) an address of the at least one interface entity (GW-V) of said second communication subsystem (V-NW) to said call control entity (H-CSCF) of said first communication subsystem (H-NW), if it is determined (S33, S35a) that the call control entity of said first subsystem (H-NW) is in charge of handling calls for said roamed subscriber.

9. A method according to claim 8,
further comprising the step of
- re-routing (S39), by said call control entity (H-CSCF) of said first communication subsystem (H-NW), the call to the interface (GW-V) of said second communication subsystem specified by said address.

10. A method according to claim 8, wherein
said address is submitted (S37) being embedded in a call setup message.

11. A method according to claim 10, wherein
said call setup message is transmitted using a session initiation protocol (SIP).

12. A method according to claim 1, wherein
said first type of communication subsystems is packet switched, and said second type of communication subsystems is circuit switched.

13. A method according to claim 1, wherein said interface entity is a gateway functional entity.

14. A computer program product comprising a computer readable medium on which there is stored computer program code which when loaded into and executed by a computer device is adapted to execute a procedure according to any of the preceding claims 1 to 13.

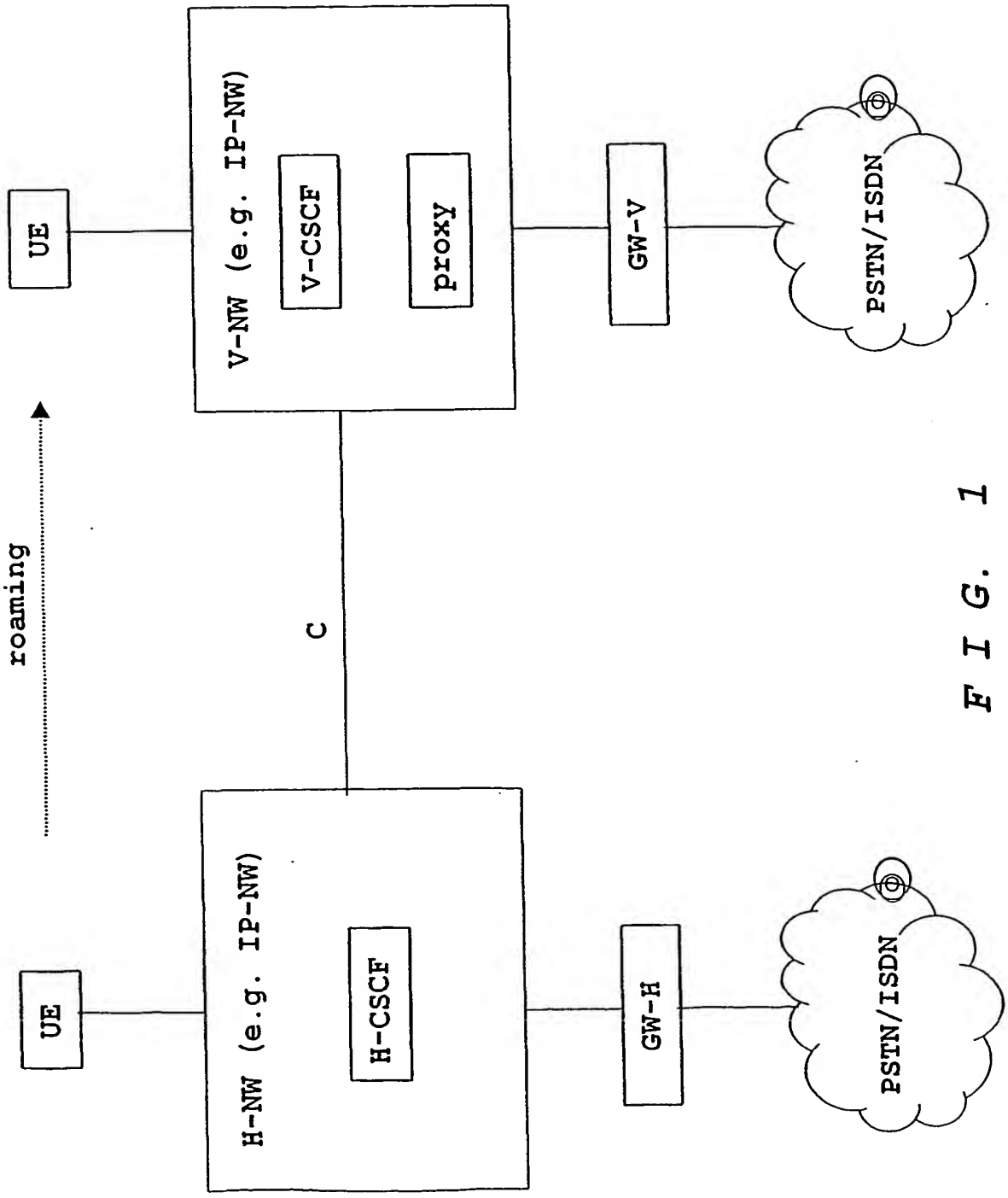


FIG. 1

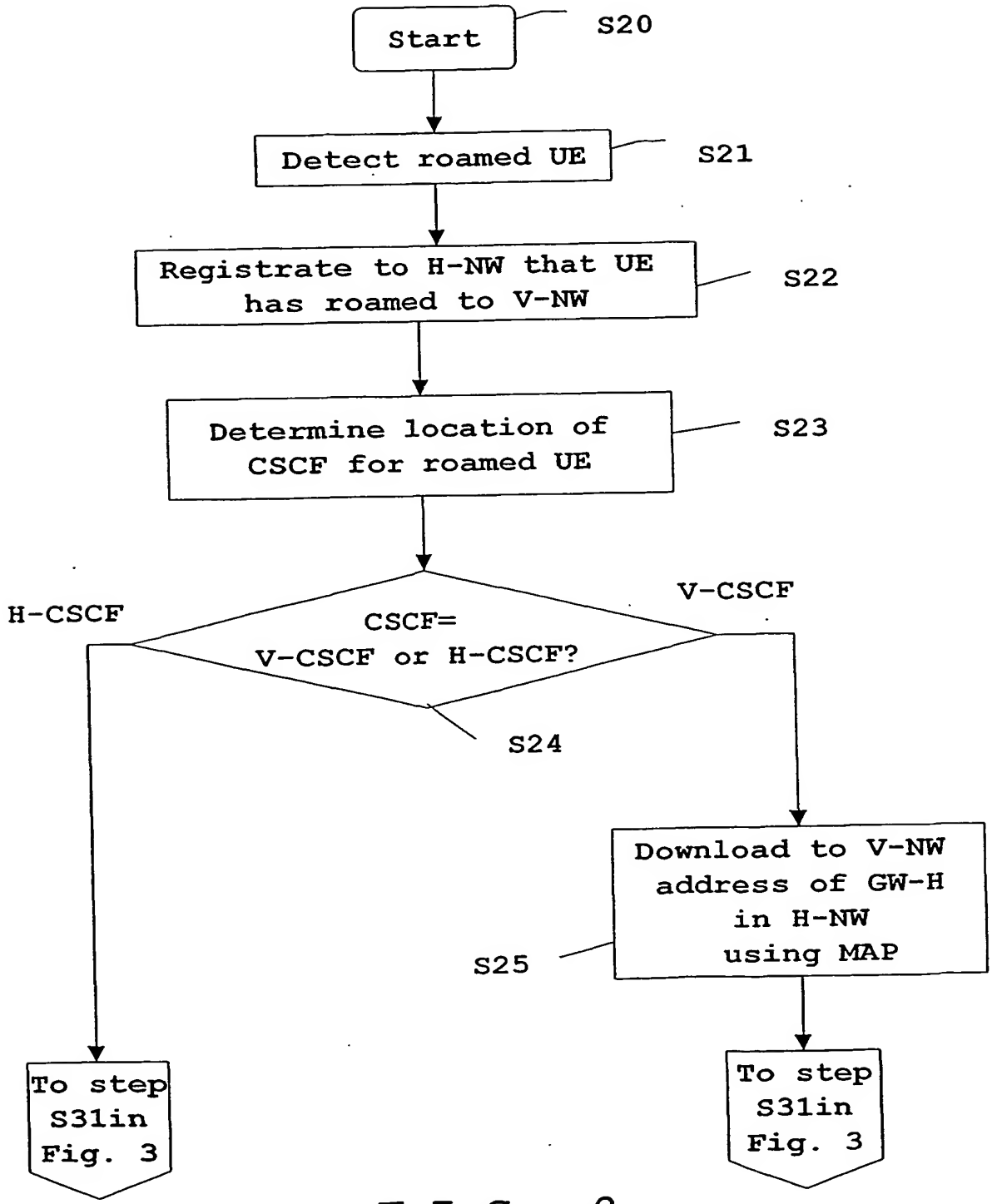


FIG. 2

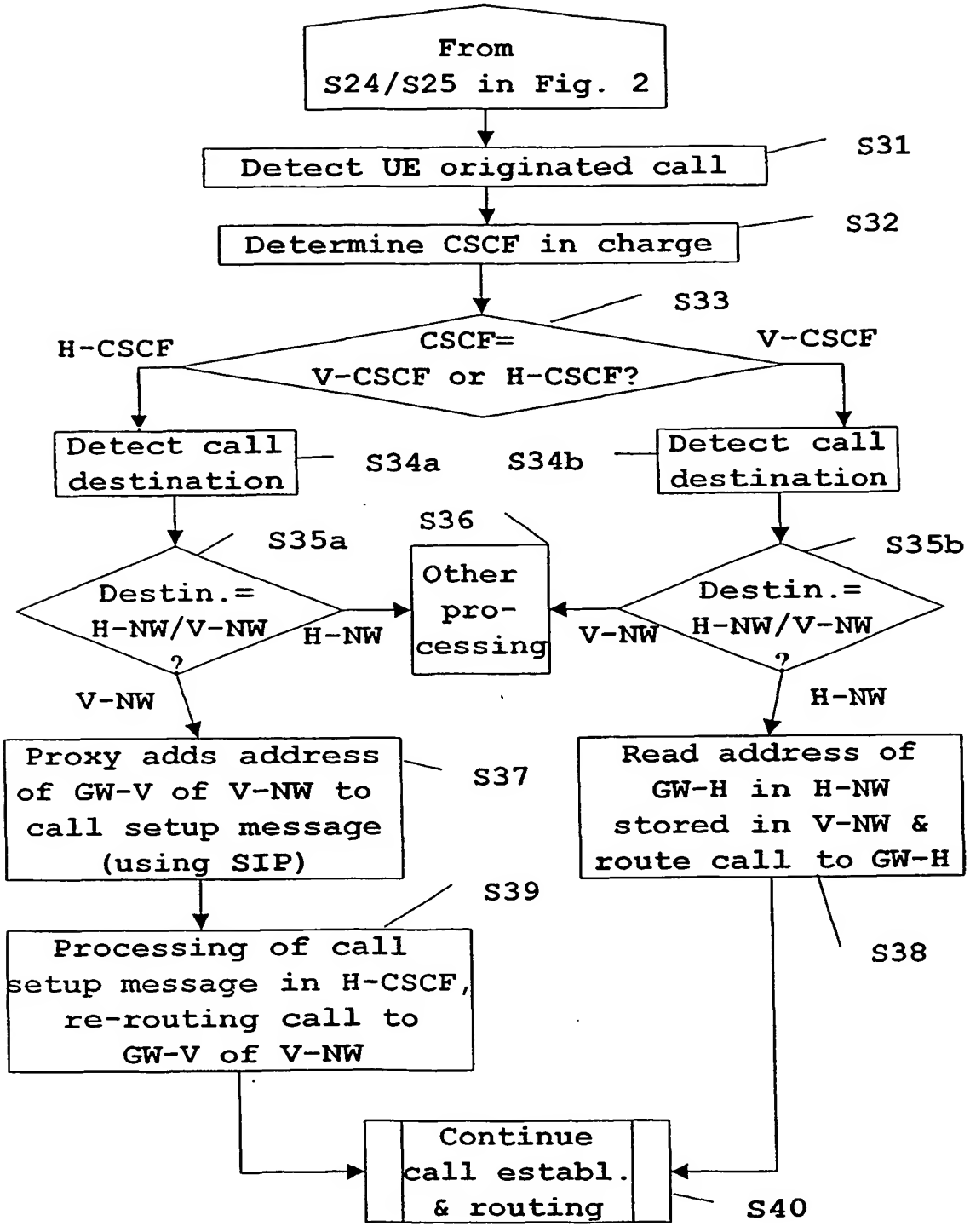


FIG. 3

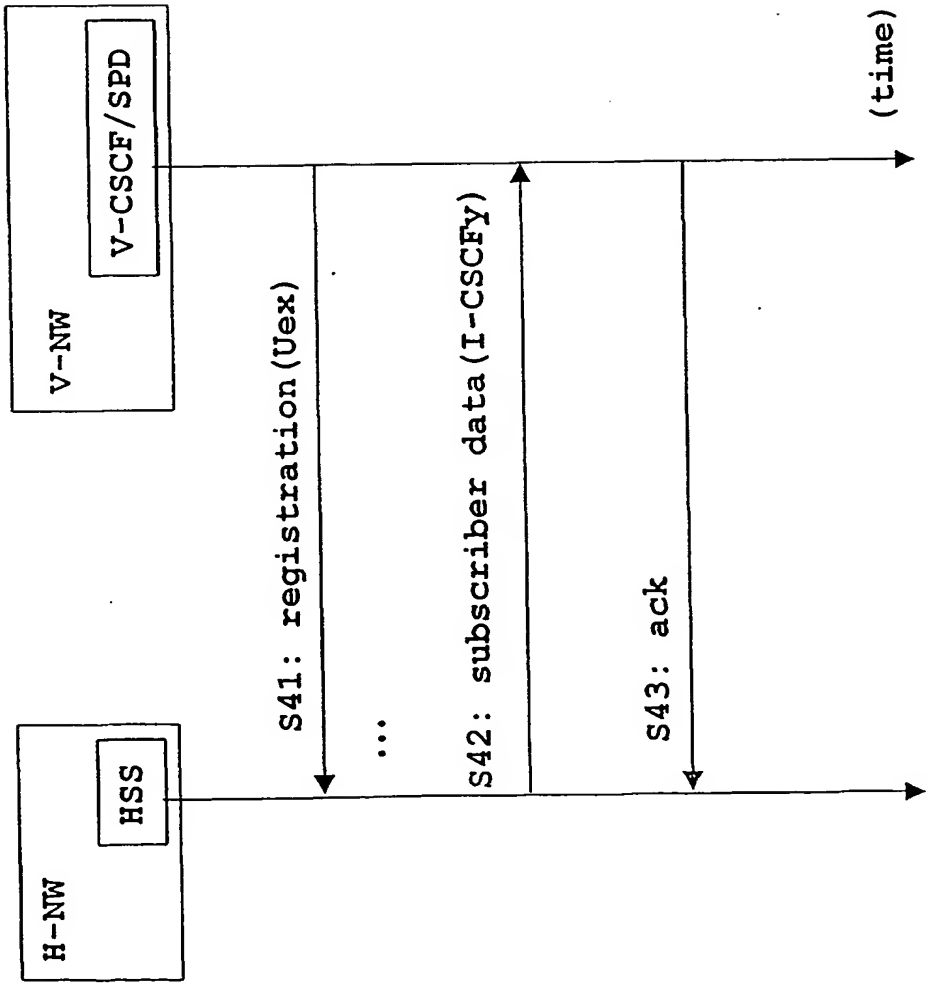


FIG. 4

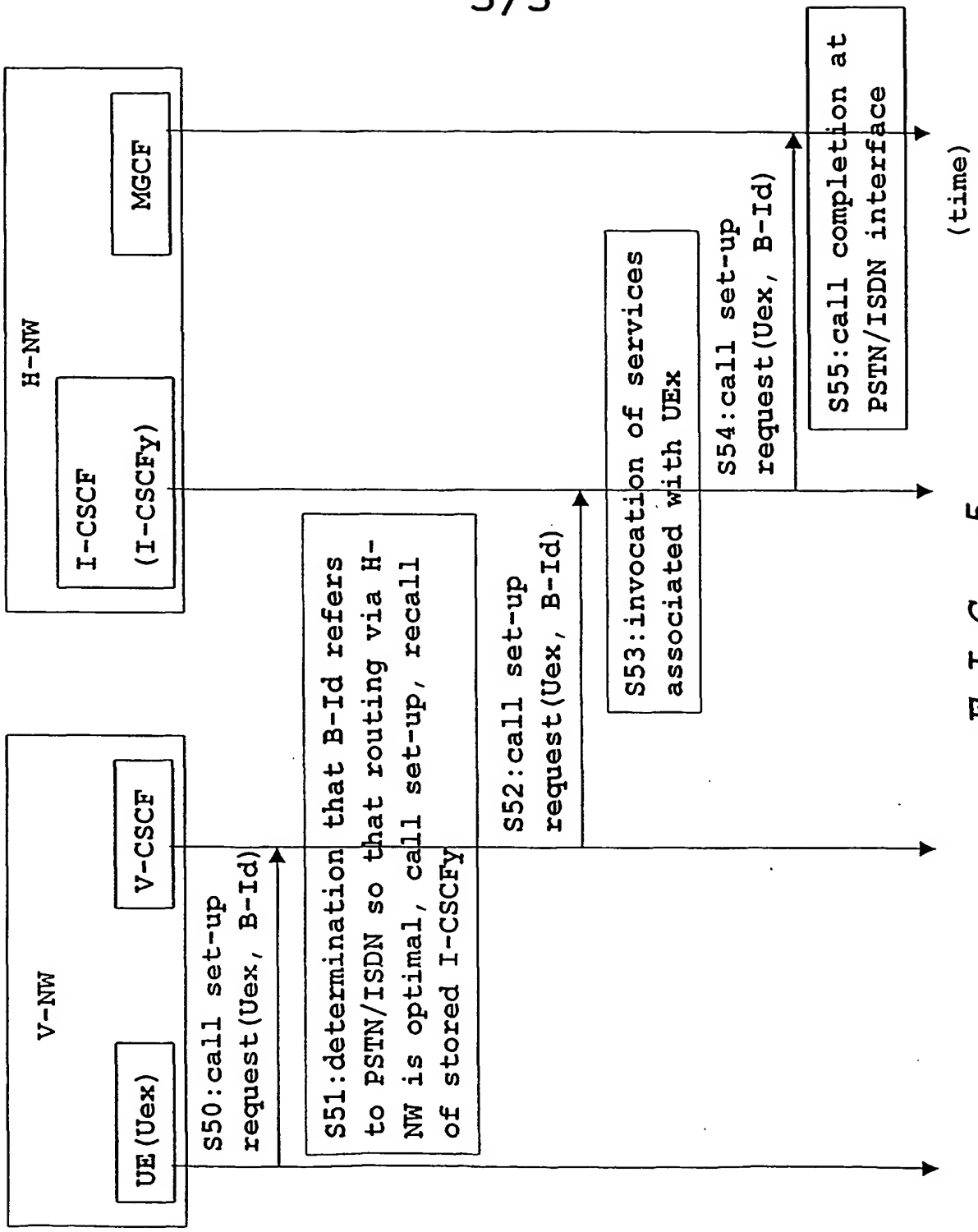


FIG. 5

INTERNATIONAL SEARCH REPORT

In plication No
PCT/EP 00/11845

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H04Q3/00 H04Q7/38 H04Q7/24

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H04Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 99 59371 A (ERICSSON INC) 18 November 1999 (1999-11-18) abstract page 2, line 7 -page 3, line 10 page 4, line 13 -page 5, line 1 page 6, line 10 -page 7, line 15	1-14
A	US 5 884 179 A (PATEL MAHESH) 16 March 1999 (1999-03-16) abstract column 2, line 31 -column 3, line 19 column 4, line 32 -column 5, line 4	1-14
A	WO 99 60801 A (ERICSSON TELEFON AB L M) 25 November 1999 (1999-11-25) abstract page 3, line 2 - line 21 page 4, line 16 -page 5, line 6	1-14

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
27 July 2001	03/08/2001

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Larcinese, C

INTERNATIONAL SEARCH REPORT

Information on patent family members

Int application No
PCT/EP 00/11845

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 9959371 A	18-11-1999	AU 3555499 A	29-11-1999
US 5884179 A	16-03-1999	AU 719420 B	11-05-2000
		AU 4347797 A	02-04-1998
		CN 1238114 A	08-12-1999
		EP 0925704 A	30-06-1999
		WO 9811751 A	19-03-1998
WO 9960801 A	25-11-1999	AU 4662999 A	06-12-1999
		BR 9910633 A	30-01-2001
		CN 1301465 T	27-06-2001
		EP 1078537 A	28-02-2001